Test Shipment of Hawaii-Grown Ornamentals by Surface Transportation

Ernest K. Akamine and Theodore Goo

Hawaii Agricultural Experiment Station • College of Tropical Agriculture
University of Hawaii • Departmental Paper 52

CONTENTS

	Page
Procedure	1
Results	2
Arrival Condition	2
Daily Condition for 3 Days after Arrival	2
Follow-up Observations	3
Discussion and Suggestions	3
Summary	4
Literature Cited	4

ACKNOWLEDGMENTS

Appreciation is gratefully acknowledged to the many individuals and firms involved in this shipment of ornamentals. The potted plants and rooted and unrooted cuttings and the labor to load the container with plants were supplied by Mr. Tamotsu Kitagawa of the Kohala Nursery, and Orchid Pacifica supplied the orchid plants. Mr. Kitagawa also assisted in the evaluation of the shipment after it arrived in California. Mr. Harold Tanoue of Hawaiian Anthuriums, Ltd., provided the anthurium flowers and ti leaves. Matson Navigation Company provided the container and shipping, and Puna Papaya Company provided the recording thermometers. Lawndale Nurseries provided space for storage of the shipment and assisted in the observations. Mr. Yoshio Watanabe of the Hawaii County Department of Research and Development did much of the coordination for the endeavor, and Mr. Masao Hanaoka of the Hawaii State Department of Agriculture assisted with the clearance of certain aspects of quarantine regulations.

THE AUTHORS

ERNEST K. AKAMINE is Plant Physiologist, Hawaii Agricultural Experiment Station, Acting Chairman, Department of Botany, and Professor of Plant Physiology, College of Tropical Agriculture, University of Hawaii.

THEODORE GOO is Research Associate, Hawaii Agricultural Experiment Station, Department of Botany, College of Tropical Agriculture, University of Hawaii.

Test Shipment of Hawaii-Grown Ornamentals by Surface Transportation

Ernest K. Akamine and Theodore Goo

Currently, all Hawaii-grown ornamentals (cut flowers, foliages, rooted and unrooted cuttings, and potted plants) are shipped by air to the Mainland United States, Japan, Europe, and other market areas. Because air-shipping costs have drastically increased in the last few years--up to more than 50 percent--and refrigerated container shipping is available at shipping rates much lower than those of air shipment, the ornamental industry requested that surface shipping tests be conducted to ascertain the feasibility of this method of transportation. This paper is a report on one test shipment.[1]

PROCEDURE

A commercial, refrigerated Matson Navigation Company container (8 feet x 24 feet) was trucked from Hilo to the Kohala Nursery on the Island of Hawaii. The plants used for the shipping test (Table 1) were sprayed with a nematocide-insecticide ("Vydate") before being placed in the container. Loading of plants in the container began on November 9, 1976 and concluded the following day. Large plants (dracaena, palms, panax, etc.) were placed on the container floor, and the pots and plants were securely fastened to each other with boards and twine. The tops of these plants were confined in tubes of wrapping paper to prevent damage to the foliage and to conserve container space. Small, sturdy plants (areca palm, panax, ti, etc.) were nestled among the larger plants and securely fastened to them. Small, delicate plants (dwarf brassaia, dendrobium, etc.) were placed in trays, which were then securely fastened to the top of a shelf; a closed fiberboard carton (lined with a plastic lining) that contained tip cuttings, both rooted (without the rooting media) and unrooted, was also on the shelf.

Light in the container was provided by three 60-watt and one 100-watt incandescent lamps suspended from the ceiling of the container. Eight cloth packages (15 grams each) of "Purafil," a commercial preparation of activated alumina impregnated with potassium permanganate (Liu, 1970), were placed in different locations in the container to inactivate ethylene produced by the plants. Four cans (each 1-gallon volume) containing water-saturated agar and another similar can containing one block of water-saturated "Instant Oasis," used in floral arrangement, were also placed in different locations in the container to provide humidity. Seven recording thermometers were placed among the plants, and the container's temperature control mechanism was set for 60°F.

On November 11, the partially full container was trucked to Hilo where it was loaded with 54 large commercial cartons, each containing 12 dozen anthurium flowers (variety 'Kaumana'), and 1 large carton filled with green ti leaves, thus filling the container to capacity.

The container departed on a Maston Navigation Company freighter from Hilo, Island of Hawaii, on November 12 and arrived in Oakland, California, on November 17. Prearrangement had been made to avoid the quarantine inspection of plants normally conducted at this port of entry. The container was then trucked to Lawndale Nurseries, Inc., in Lawndale, California (near Los Angeles),

---

[1]Since the writing of this departmental paper, we have been informed that commercial weekly shipments to the Mainland United States from the Kohala Nursery by surface transportation began shortly after this test.

Table 1. Plants used in the shipping test

Plant or cutting	Scientific name	Common name or variety	Number of plants or cuttings	Size of pots (inches)
Potted plants (total 658)	Polyscias fruticosa	panax	256	4 and 5
	Chrysalidocarpus lutescens	areca palm	67	4 and 14
	Brassaia actinophylla	schefflera	22	4 and 14
	Brassaia arboracola	dwarf brassaia	59	2 and 8
	Dracaena warnecki	dracaena	94[a]	8 and 14
	Dracaena marginata	dracaena	60[a]	8 and 14
	Chamaedorea elegans	chamaedorea palm	10	8
	Dieffenbachia amoena	dieffenbachia	5	8
	Dieffenbachia picta	'Rudolph Roehrs'	5	8
	Cordyline terminalis	'Hawaiian Beauty' ti	30	4 and 8
	Polypodium mandaianum	hares-foot fern	9	6
	Chloranthus inconspicuus	chloranthus	9	6
	Asplenium nidus	birds-nest fern	16	4
	Archontophoenix alexandrae	Hilo palm	6	4
	Dendrobium sp.	dendrobium hybrid	10[b]	3
Rooted tip cuttings (total 12)	Dieffenbachia amoena	dieffenbachia	6	
	Dieffenbachia picta	'Rudolph Roehrs'	6	
Unrooted tip cuttings (total 50)	Dracaena marginata	dracaena	50	

[a]Plants up to 8 feet high.

[b]Flowering plants.

on November 18, where initial examination of the shipment was made after inspection by a quarantine officer. For the next 3 days, observations on the shipment were made by us, and thereafter the management of the nursery was requested to continue observations and report any significant adverse changes in the condition of the plants to us.

RESULTS

Arrival Condition

An initial examination of the shipment on arrival at the nursery showed that (1) the interior temperature of the container ranged from 60-65°F, (2) all lamps were on, (3) "Purafil" was still in an active condition for inactivating ethylene, and (4) the agar and "Instant Oasis" blocks were still saturated with water. Excluding a few plants that fell to the floor of the container from their lodging among the larger plants, there was no evidence of any major movement or shifting of plants inside the container. There was some wilting of delicate plants (dendrobium spikes and leaves of the two species of brassaia and chloranthus) due to desiccation, but the arrival condition of the plants, in general, was judged satisfactory, especially in view of the extended shipping period (a total of 9 days in the container). The anthurium flowers and green ti leaves also arrived in good condition and were subsequently air-shipped to Rome, Italy.

Daily Condition for 3 Days after Arrival

A few very young leaflets (about 2 percent) of the two species of brassaia that wilted abscised in the nursery, but the plants recovered from the wilt with watering, which also cor-

rected the twisting or curling of the stems of chloranthus. The dendrobium spikes also recovered from wilting with watering, but some flowers (two to three per spike) abscised. Some of the larger plants (two species of dracaena and areca palm) were being transplanted into larger, permanent pots by the end of the third day after arrival. These and the other plants were in a satisfactory condition on this day.

Follow-up Observations

Up to the writing of this report (4 months after arrival of the shipment in California), no significant adverse conditions of the plants have been reported by the management of Lawndale Nurseries or of Kohala Nursery.

DISCUSSION AND SUGGESTIONS

Since very little is known about the requirements of shipping ornamentals by marine shipment, and, since this was the first controlled shipping test that was actually a commercial shipment, we assumed the worst would happen and provided means to prevent any adverse eventuality. Thus, light was provided on the assumption that some plants might not tolerate total darkness during the transit period (Staby et al., 1976), and "Purafil" was installed to inactivate the ethylene produced by plants that could cause leaf abscission if the gas accumulated in the container. On the assumption that desiccation of plants would occur because of the limited water-holding capacity of the media of the potted plants continuously subjected to the rapidly circulating air in the container, water-saturated agar and "Instant Oasis" were installed to provide humidity and, thus, minimize desiccation. Based on results of limited laboratory experiments and published data (Staby et al., 1976), a temperature of about 60°F was used on the assumption that it could be the average optimum temperature for shipping the different plants in the same container and because it is only slightly higher than the recommended storage temperature of 56°F for anthurium flowers (Kamemoto, 1962). Assuming that excessive accumulation of carbon dioxide from respiring plants could damage the plants and flowers, lime (calcium hydroxide) to absorb the gas was to have been installed in the container but was inadvertently left out.

The only significant factor adversely affecting the plants was desiccation, but it affected only the less hardy plants. This indicates, however, that if these plants are to be shipped together with hardier plants in the same container, provision must be made to supply more moisture to the less hardy plants through the root system by modifying the composition of the potting media to facilitate retention of moisture for longer periods. The addition of some vermiculite, peat moss, or "Hydrogel" (Still, 1976) to the potting mixture (shredded tree fern (hapu'u) + volcanic cinders) used in this test would increase the water-retaining capacity of the media. Also, protection from the direct draft of the air-circulation system in the container and increasing the relative humidity would minimize wilting of less hardy plants.

It is very unlikely that ethylene and carbon dioxide accumulated to levels injurious to the plants because there are four openings (each about 1/2 inch in diameter) on the container floor to drain water and to prevent undue atmospheric pressure changes to occur within the container. Therefore, the precautionary measure taken to inactivate ethylene was probably unnecessary, and the omission of lime to absorb carbon dioxide was likewise of no significance.

Due to the varying sizes of the plants and the compactness of the load, the light distribution in the container was not uniform. Nevertheless, whether light, as used in the test, was necessary or optimum for the shipment is not known, and whether the temperature maintained in the container was the optimum is also uncertain. More experimentation is required to determine the optimum amount and kind of light and temperature required for surface shipment of all plants.

Since greenhouse conditions are very different from conditions inside a shipping container, some plants may have to be conditioned or acclimatized to tolerate the shipping conditions. It is important to determine the effects of light, temperature, water, air circulation, and methods of loading using simulated conditions before actual shipment. As long as containers similar to the Matson container used in this test are used it is unlikely that ethylene and carbon dioxide will pose any serious threat to the shipping of ornamentals by surface transportation.

SUMMARY

In general, this test shipment was a success with a minimum number of damaged plants. It demonstrated the feasibility of surface shipment of ornamentals, especially the large and sturdy plants, such as Dracaena marginata, areca palm, Polyscias fruticosa, and Brassaia actinophylla, all of which are difficult or impossible to ship by air.

Desiccation of the delicate plants was the only major problem encountered in this test. Possible methods to alleviate this factor are suggested: (1) modifying the potting media to increase its water-holding capacity, (2) protecting the plants from the direct draft of the air-circulating system of the container, and (3) increasing the relative humidity of the container.

Further studies under simulated shipping conditions are recommended to determine the effects and requirements of light, temperature, water, air circulation, and loading methods.

LITERATURE CITED

Kamemoto, H. 1962. Some factors affecting the keeping quality of anthurium flowers. Hawaii Farm Sci. 11(4):2-4.

Liu, F. W. 1970. Storage of bananas in polyethylene bags with an ethylene absorbent. HortScience 5(1):25-27.

Staby, G. L., J. L. Robertson, D. C. Kiplinger, and C. A. Conover. 1976. Proceedings of National Floricultural Conference on Commodity Handling, Chicago, Illinois, Feb. 23, 1976. Horticultural Series Number 432, Ohio Florists' Association, Columbus, Ohio.

Still, S. M. 1976. Growth of 'Sunny Mandalay' chrysanthemums in hardwood-bark-amended media as affected by insolubilized poly (ethylene oxide). HortScience 11(5):483-484.

DISCLAIMER

Reference to a company or product name does not imply approval or recommendation of the product by the College of Tropical Agriculture, University of Hawaii, or the United States Department of Agriculture to the exclusion of others that may be suitable.

Single copies of this publication available without charge to **Hawaii residents** from county agents. **Out-of-State** inquiries or **bulk orders** should be sent to the College of Tropical Agriculture Order Desk, Room 108 Krauss Hall, 2500 Dole Street, Honolulu, Hawaii 96822. Price per copy to bulk users, twelve cents plus postage.

Hawaii Agricultural Experiment Station, College of Tropical Agriculture, University of Hawaii
William R. Furtick, Dean of the College and Director of the Experiment Station
Noel P. Kefford, Acting Associate Director of the Experiment Station
Departmental Paper 52—June 1977 (3 M)